# BULLETIN

## OF THE INSTITUTE OF METALS

VOLUME 3 SEPTEMBER 1955 PART 1

## INSTITUTE NEWS

### Presentation of Institute of Metals (Platinum) Medal

The presentation of the Institute of Metals (Platinum) Medal for 1955 will be made to Dr. C. J. SMITHELLS, M.C., F.I.M., at 9.30 a.m. on Thursday, 22 September at the Palace Hotel, Buxton. The award was announced at the beginning of the year, but Dr. Smithells was unable to be present to receive the medal at the Annual General Meeting in March.

The award was made to Dr. Smithells in recognition of his services to metallurgical science, to the metal industries, and to the metallurgical profession.

### Symposium on the Mechanism of Phase Transformations in Metals

A one-day symposium on "The Mechanism of Phase Transformations in Metals", organized by the Metal Physics Committee of the Institute, will be held on Wednesday, 9 November 1955, at the Royal Institution, Albemarle Street, London, W.1.

The morning session, beginning at 10 a.m., will be devoted to transformations of the nucleation-and-growth type, and the afternoon session to martensitic transformations. Comprehensive review papers covering these two branches of the subject have been prepared, and in addition sixteen papers reporting original research in the field of phase transformations will be presented by rapporteurs for discussion.

A programme of the meeting and reply form will be circulated to all European members; other members may obtain a copy on application to the Secretary. Attendance at the meeting will be free to all who are interested in the subject, but non-members of the Institute who wish to receive the papers must apply to the Secretary, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1, for a registration form.

To stimulate discussion, advance copies of the papers will be supplied to those who register (fee 10*s*.), but the Council particularly requests that those who cannot attend the meeting should *not* apply for advance copies, which are printed solely to stimulate discussion and will be strictly limited in number. All the papers, together with a report of the discussion, will subsequently be published (cloth-bound) as No. 18 in the Institute of Metals Monograph and Report Series.

#### List of Papers

*Morning Session*

Nucleation-and-Growth Processes in Metals and Alloys. By H. K. Hardy and T. J. Heal (Fulmer Research Institute).

Effects of Nucleation Site upon Precipitate Morphology. By H. I. Aaronson (Carnegie Institute of Technology).

The Precipitation of the θ′ Phase in Aluminium–4% Copper Alloys. By G. Thomas and J. Nutting (University of Cambridge).

A Resistometric Study of the Kinetics of Precipitation in Lead–Tin Alloys. By Professor G. Borelius and L. E. Larsson (Kungl. Tekniska Högskolan, Stockholm).

Superlattice Formation in the Alloy $CdMg_3$. By H. Steeple and Professor H. Lipson (College of Technology, Manchester).

The $\beta \rightarrow \alpha$ Transformation in Pure Tin and Its Dilute Alloys. By E. O. Hall (University of Sheffield).

The Structure of the ω Precipitate in Titanium–16% Vanadium Alloy. By (Miss) J. M. Silcock, M. H. Davies, and H. K. Hardy (Fulmer Research Institute).

Sigma-Phase Nucleation and Other Transformations During Diffusion in the Iron–Chromium System. By H. J. Goldschmidt (B.S.A. Group Research Centre).

*Afternoon Session*

Martensitic Transformations. By B. A. Bilby (University of Sheffield) and J. W. Christian (University of Oxford).

The Nucleation Problem in Martensite. By M. A. Jaswon (Imperial College of Science and Technology, London).

Homogeneous *versus* Heterogeneous Nucleation in the Martensitic Transformation. By Larry Kaufman and Professor Morris Cohen (Massachusetts Institute of Technology).

Crystal Geometry of the Austenite–Martensite Transformation. By T. Ll. Richards and W. T. Roberts (Imperial Chemical Industries, Ltd., Metals Division).

The Allotropic Transformation of Cobalt. By François Sebilleau and Hervé Bibring (Office National d'Etudes et de Recherches Aéronautiques).

The Diffusionless Transformations of Metastable β-Brass. By D. Hull and R. D. Garwood (University College, Cardiff).

The Crystallography of the $\beta \rightarrow \alpha$ Phase Transformation in Uranium–1·4 Atomic Per Cent. Chromium Alloy. By B. R. Butcher and A. H. Rowe (Atomic Energy Research Establishment, Harwell).

The $\beta \rightarrow \alpha$ Transformation in Uranium–1·4 Atomic Per Cent. Chromium Alloy. By W. M. Lomer (Atomic Energy Research Establishment, Harwell).

The Bainite Reaction in High-Carbon Steels. By O. Krisement and Professor F. Wever (Max-Planck-Institut für Eisenforschung, Düsseldorf).

The Stabilization of Austenite. By S. G. Glover and T. B. Smith (University of Birmingham).

## Extraordinary General Meeting

NOTICE IS HEREBY GIVEN that an EXTRAORDINARY GENERAL MEETING of the Members of THE INSTITUTE OF METALS will be held at the Palace Hotel, BUXTON, on Thursday the twenty second day of September 1955 at 9.15 o'clock in the forenoon for the purpose of considering and, if thought fit, passing the following Resolution as a Special Resolution.

### SPECIAL RESOLUTION

THAT the Articles of Association of the Institute be amended in manner following, that is to say :—

(*a*) In Article 5 by the deletion of the word " or " and the insertion after the words " Student Members " of the words " or Overseas Sustaining Members ".

(*b*) In Article 6 by the insertion immediately prior to the ultimate paragraph of such Article of the following new paragraphs :—

*Overseas Sustaining Members* shall be such bodies corporate having their headquarters or principal places of business outside the United Kingdom of Great Britain and Northern Ireland and desiring to give financial support to the objects and work of the Institute, as the Council in its absolute discretion shall admit as Overseas Sustaining Members. The decision of the Council on the question of eligibility for admission as an Overseas Sustaining Member shall be final.

An Overseas Sustaining Member shall be entitled to nominate not more than two individuals for membership of the Institute and further individuals from time to time in place of any such nominee not being elected or ceasing to be a nominated Member provided that an individual so nominated must be eligible for election as an Ordinary Member, Junior Member, or Student Member and shall submit a signed application for membership and shall be subject to election by the Council in accordance with these Articles.

An Overseas Sustaining Member shall not be qualified for election to the Council. An Overseas Sustaining Member shall neither be entitled to receive notice of nor to attend nor vote at any General Meeting of the Institute nor to vote upon a ballot. Save as herein otherwise provided, a Member nominated by an Overseas Sustaining Member shall have all the rights and privileges and shall be subject to the conditions appertaining to the class of membership to which he shall be admitted. Save as aforesaid, during any period in which there shall be no individual Member nominated by a particular Overseas Sustaining Member, then such Overseas Sustaining Member shall have all the rights and privileges and shall be subject to the conditions appertaining to an Ordinary Member.

A Member nominated by an Overseas Sustaining Member shall be entitled at any time during membership to elect by notice in writing to the Council as from the date of service of such notice to continue in membership in his own right and in all respects as if he were not a nominated member.

All nominations by an Overseas Sustaining Member and revocations of such nominations shall be made in writing under the hand of an officer duly authorized in that behalf by the Board of Directors or equivalent governing body of such Overseas Sustaining Member.

(*c*) In Article 8 by the deletion of the word " or " where it first occurs and the insertion after the words " Student Members " of the words " or Overseas Sustaining Members ".

(*d*) In Article 9 by the insertion of the following new paragraph to be numbered 9 (b) and the renumbering of the existing paragraphs 9 (b), 9 (c), and 9 (d) to read 9 (c), 9 (d), and 9 (e) respectively :—

(b) Unless and until otherwise determined by the Council or provided by the bye-laws, each Overseas Sustaining Member shall pay a minimum annual subscription of £25. Such subscription shall be deemed to include the annual subscription of the individual Member or Members nominated by such Overseas Sustaining Member.

(*e*) In Article 15 by the insertion of the following new paragraph to be lettered (f) :—

(f) If, in the case of a Member nominated by an Overseas Sustaining Member, such Overseas Sustaining Member shall give to the Council and to the nominated Member not less than fourteen days' notice in writing revoking such nomination or if the Overseas Sustaining Member shall cease to be a Member of the Institute.

(*f*) In Article 55 by the insertion of the following words at the commencement of the Article :

" Subject as hereinbefore provided as to Overseas Sustaining Members ".

DATED the nineteenth day of May, 1955.

By Order of the Council.

S. C. GUILLAN.
*Secretary.*

*Registered Office:*
4 Grosvenor Gardens,
London, S.W.1.

## Election of Members

The following 16 Ordinary Members, 1 Junior Member, and 12 Student Members were elected on 30 June 1955 :

*As Ordinary Members*

CARNALL, Fred Malam, Mill Manager, Northern Aluminium Co., Ltd., Banbury, Oxon.

CLARK, Peter Sidney John, Tool Steel Engineer, Research and Testing Department, Gebr. Böhler and Co., A.G., Hansa Allee 321, Düsseldorf-Oberkassel, Germany.

DICKENSON, John Henry Mayger, A.I.M., Metallurgist, William Jessop and Sons, Ltd., Brightside Works, Sheffield.

FLASCK, Arthur Ronald, B.S.Met.Eng., Plant Metallurgist, Brass Division Plants 5 and 8, Bohn Aluminum and Brass Corp., 2601 Clay Avenue, Detroit, Mich., U.S.A.

HUCKLESBY, Frederick Dorrien, Senior Technical Assistant, Sales Technical Service Department, British Oxygen Co., Ltd., London, N.W.2.

JOYCE, Eric Michael Hearn, Managing Director, Oakes, Turner and Co., Ltd., 75/79 Eyre Street, Sheffield 1.

LANGSTEINER, Rudolf, Eng.Mont., Chief Metallurgist, Sociedad Metalurgica-Minera-Siderurgica Industrias RAB S.A., Rio Cuarto 1964, Buenos Aires, Argentina.

LAY, James Owen, F.R.I.C., Metallurgical Chemist, Burndept, Ltd., West Street, Erith, Kent.

LOVELL, Harry Ralph, Assistant to the Managing Director, Oakes, Turner and Co., Ltd., 75/79 Eyre Street, Sheffield 1.

MEYERHOFF, Louis, B.S., Director of Research, General Cable Corp., Bayonne, N.J., U.S.A.

PIPE, Cyril Rees, M.Sc., F.I.M., Metallurgist, R.T.S.C. Laboratories, Whitchurch, Aylesbury, Bucks.

PLUMBE, Wilfred John, F.L.A., Acting Librarian, University of Malaya, Cluny Road, Singapore 10.

SMITH, Harold Sydney, L.I.M., Metallurgist, Hoover, Ltd., Perivale, Greenford, Middx.

DE WINTON, Cenydd Blanch Harding, Assistant Production Manager, Northern Aluminium Co., Ltd., Rogerstone, Newport, Mon.

WORMLEIGHTON, Albert Norton, Works Director, The Phosphor Bronze Co., Ltd., Bradford Street, Birmingham 5.

YOKELSON, Marshall V., B.Ch.E., M.Met.E., Research Metallurgist, General Cable Corp., Bayonne, N.J., U.S.A.

*As Junior Member*

CARSON, Neill James, B.S., Graduate Student, School of Chemical and Metallurgical Engineering, Purdue University, West Lafayette, Ind., U.S.A.

*As Student Members*

CORNELL, Marion Howard, B.S.Met.Eng., Graduate Student, School of Chemical and Metallurgical Engineering, Purdue University, West Lafayette, Ind., U.S.A.

GALLIGAN, James M., 78 Hartwell Place, Woodmere, New York, U.S.A.

GEISELMAN, Doyle, B.S.Met.Eng., Graduate Student, School of Chemical and Metallurgical Engineering, Purdue University, West Lafayette, Ind., U.S.A.

KASHYAP, Vikash Chander, M.S., Graduate Student, School of Chemical and Metallurgical Engineering, Purdue University, West Lafayette, Ind., U.S.A.

LLOYD, Eric Douglas, Undergraduate, Department of Metallurgy, University of Manchester.

MARCINKOWSKI, Marion, B.S., Graduate Student in Metallurgy, University of Pennsylvania, Philadelphia 4, Pa., U.S.A.

MORRIS, James Graham, B.S.Met.Eng., Graduate Student, School of Chemical and Metallurgical Engineering, Purdue University, West Lafayette, Ind., U.S.A.

PHELPS, William C., Jr., B.S.Met.Eng., Graduate Student, School of Chemical and Metallurgical Engineering, Purdue University, West Lafayette, Ind., U.S.A.

SMITH, Colin Charles, Undergraduate, Department of Metallurgy, University of Manchester.

TOWNER, Jeremy Michael, Student of Metallurgy, Battersea College of Technology, London, S.W.11.

WAYMAN, Clarence Marvin, B.S., Alcoa Research Fellow, School of Chemical and Metallurgical Engineering, Purdue University, West Lafayette, Ind., U.S.A.

YUE, Alfred S., M.S., Graduate Student, School of Chemical and Metallurgical Engineering, Purdue University, West Lafayette, Ind., U.S.A.

The following 19 Ordinary Members, 1 Junior Member, and 2 Student Members were elected on 1 August 1955:

*As Ordinary Members*

ANSELL, Roy Crawford, B.Sc., Assistant Works Metallurgist, Northern Aluminium Co., Ltd., Banbury, Oxon.

BARNSLEY, Ronald, B.Sc., Metallurgist, British Driver-Harris Co., Ltd., Bird Hall Lane, Cheadle Heath, Stockport, Cheshire.

BERBERIAN, Karnig A., B.S., Metallurgist, Raytheon Manufacturing Co., 55 Chapel Street, Newton 58, Mass., U.S.A.

BERRIE, Robert, Director and Secretary, R. Berrie and Co., Ltd., 127 Hydepark Street, Glasgow, C.3.

BERRIE, William, Managing Director, R. Berrie and Co. Ltd., 127 Hydepark Street, Glasgow, C.3.

GLICK, William Woolf, A.I.M., Investigator, The British Non-Ferrous Metals Research Association, Euston Street, London, N.W.1.

JOHNSON, Ernest R., Vice-President in Charge of Operations, Republic Steel Corp., Republic Building, Cleveland, Ohio, U.S.A.

KAMURA, Heihachi, M.S., Dr. Eng., President, Kyushu Institute of Technology, Tobata-Shi, Fukuoka-Ken, Japan.

LEACH, Walter Norman, B.Sc., A.I.M., Research Manager, British Driver-Harris Co., Ltd., Bird Hall Lane, Cheadle Heath, Stockport, Cheshire.

LEVICK, Spencer Swift, Chairman and Managing Director, Swift Levick and Sons, Ltd., Clarence Steel Works, Sheffield 4.

LIMB, Harold Roscoe, B.Sc., Scientific Officer, Defence Standards Laboratories, c/o P.O. Woodville, South Australia.

MANSON, John Eric, B.Sc., Experimental Officer, United Kingdom Atomic Energy Authority, Industrial Group, Research and Development Laboratory, Culcheth, nr. Warrington, Lancs.

MARTIN, Dennis Frederick, Assistant Lecturer in Mechanical Engineering, Borough Polytechnic, Borough Road, London, S.E.1.

MORRISON, Charles, Foundry Manager, R. Berrie and Co., Ltd., 127 Hydepark Street, Glasgow, C.3.

NOWAK, Stanislaw Kazimierz, Dr.Ing., Research Metallurgist, Physical Metallurgy Department, Aluminium Laboratories, Ltd., Kingston, Ont., Canada.

ROBECK, Clausen Adolf, B.Eng., Vice-President and Superintendent, The Gibson and Kirk Co., Warner and Bayard Streets, Baltimore 30, Md., U.S.A.

ROWLEY, Mervin Thomas, M.S., Chief Metallurgist, The Ohio Injector Co., 275 Main Street, Wadsworth, Ohio, U.S.A.

RUIZ, Julie Héctor, Guillerme Decker S.A., Belgrano 836, Buenos Aires, Argentina.

WRIGLESWORTH, Alan George, B.Sc., Metallurgist, British Driver-Harris Co., Ltd., Bird Hall Lane, Cheadle Heath, Stockport, Cheshire.

*As Junior Member*

RAPPERPORT, Eugene John, Sc.D., Metallurgist, Nuclear Metals Inc., 155 Massachusetts Avenue, Cambridge 38, Mass., U.S.A.

*As Student Members*

BENNETT, Malcolm Gordon, Trainee Metallurgist, Development and Research Department, The Mond Nickel Co., Ltd., Thames House, London, S.W.1.

STOREY, Gordon Graham, Undergraduate, Department of Metallurgy, University of Birmingham.

### "Journal" and "Metallurgical Abstracts" Bound Volumes Required

Bound volumes of the *Journal* from 1908 to 1930 (Volumes 1–44) are required in sets or as single volumes. The condition of the binding is immaterial, as it is intended to rebind these volumes. The printed matter must be in perfect unmarked condition. The Institute will pay 7*s.* 6*d.* for each volume.

The Institute will pay £1 each for bound volumes in good condition of the following:

*Journal*: 1940 (Vol. 66) and 1942 (Vol. 68).

*Metallurgical Abstracts*: 1940 (Vol. 7), 1941 (Vol. 8), 1942 (Vol. 9), 1943 (Vol. 10), and 1945 (Vol. 12).

Volumes should be sent to the Secretary, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

# PERSONAL NOTES

Dr. W. O. Alexander, of Imperial Chemical Industries, Ltd., Metals Division, has been seconded to I.C.I. New York, 488 Madison Avenue, New York, for a period of about three years.

Dr. D. V. Atterton has been appointed Technical Manager of Foundry Services, Ltd., Birmingham.

Mr. A. R. Bailey has been awarded a Turner and Newall Research Fellowship tenable at the Royal School of Mines, London. He has accordingly resigned his post as Senior Lecturer in Metallurgy at the Constantine Technical College, Middlesbrough.

Mr. R. L. Bell has left Birmingham University and is now a Junior Research Fellow in the Physics Department of the Radar Research Establishment, Great Malvern.

Dr. F. P. Bowden, Reader in Physical Chemistry in the University of Cambridge, has been awarded an Elliott Cresson Medal by the Franklin Institute "for his extensive experimental investigations of the friction between solid surfaces".

Mr. A. W. Brace has left the Aluminium Development Association to take up an appointment with Aluminium Laboratories, Ltd., Banbury.

Mr. W. F. Brazener has been elected President of the British Non-Ferrous Metals Federation for a second year.

Mr. E. C. Brough has joined the teaching staff at Luton Technical College.

Dr. N. K. Chen has left the Johns Hopkins University, Baltimore, and joined the staff of the Research Laboratories of the Westinghouse Electric Corp., East Pittsburgh, Pa.

Mr. P. D. Crowther has been appointed a director of Peglers, Ltd., Doncaster.

M. André Deruyttere has been awarded the Ph.D. degree of Sheffield University and also a Brunton Medal and Premium.

Mr. H. K. Farmery has been awarded the Ph.D. degree of Cambridge University. He is now Corrosion Investigator at the Fulmer Research Institute.

Mr. V. C. Faulkner, Editor of *Foundry Trade Journal*, received the Award of Honour of the International Committee of Foundry Technical Associations at the recent International Foundry Congress in London.

Mr. P. Fischer, has graduated Dipl. Ing. from the Technische Hochschule, Zürich, and taken a post with Aluminium-Industrie A.G.

Mr. D. O. Gilbey, is now with the Ashanti Goldfields Corp., Ltd., Obuasi, Gold Coast.

Mr. H. J. Goldschmidt, of the B.S.A. Group Research Centre, has been awarded the degree of D.Sc. of Manchester University.

Mr. L. T. Greenfield has left the Hoyt Metal Co. of Great Britain, Ltd., to take up the post of Foundry Manager to Deloro Stellite, Ltd., Birmingham.

Mr. D. R. Harries has left Cambridge University and is now at the Atomic Energy Research Establishment, Harwell.

Dr. C. E. Homer, Department of Development and Research, Tube Investments, Ltd., has been elected President of the Birmingham Metallurgical Society for the session 1955–56.

Dr. B. B. Hundy has left the British Iron and Steel Research Association to take up the post of Senior Research Metallurgist in the Steel, Peech, and Tozer Branch of the United Steel Companies, Ltd.

Mr. E. D. Hyman has left the American Brake Shoe Co. and is now Metallurgist in the Uranium Division of Malinckrodt Chemical Works, St. Louis, Mo.

Mr. L. W. Johnson has been appointed Assistant Manager of the Development and Research Department of The Mond Nickel Co., Ltd.

Mr. F. L. LaQue, Vice-President of the International Nickel Co., Ltd., has been appointed a Director of the American Society for Testing Materials for three years.

Mr. A. Lawley has been awarded a B.Sc. (Hons.) degree in Physical Metallurgy at Birmingham University.

Mr. P. A. Lovett has been appointed a Senior Assistant in the Publicity Department of The Mond Nickel Co., Ltd.

Mr. W. H. Lowther has recently become an Assistant Technical Officer in the Metallurgical Section of the Wilton Works of Imperial Chemical Industries, Ltd.

Dr. D. J. McPherson has been appointed Assistant Manager of the Metals Research Department, Armour Research Foundation, Chicago, Ill.

Dr. A. G. Metcalfe has been promoted to the post of Senior Metallurgist at the Armour Research Foundation, Chicago.

Professor A. J. Murphy has relinquished his position as Head of the Department of Metallurgy and Professor of Industrial Metallurgy at Birmingham University, in order to become Principal of the College of Aeronautics, Cranfield, Beds. He takes up his new appointment on 1 October.

Professor Rupert Myers, Foundation Professor of Metallurgy in the New South Wales University of Technology, has been elected a Member of Council of the University of Technology.

Mr. J. J. Norreys has joined the staff of the Research Laboratories, General Electric Co., Ltd., Wembley.

Mr. W. D. Oliphant is now Senior Lecturer in Electronics and Telecommunications at the Heriot-Watt College, Edinburgh.

Dr. A. J. Phillips has been appointed a Vice-President of the American Smelting and Refining Co. He continues to be Director of Research.

Dr. W. A. Rachinger has returned to the Aeronautical Research Laboratories, Melbourne, after working for a time in the Physical Metallurgy Department of Birmingham University.

Mr. W. F. Randall has been appointed Managing Director of a Metals Group newly established by the Telegraph Construction and Maintenance Co., Ltd.

Dr. E. C. Rhodes has been appointed Assistant to the Manager of the Development and Research Department of The Mond Nickel Co., Ltd. He will continue to be responsible for the Department's precious-metal activities.

Mr. J. F. Robinson has been awarded the B.Sc. degree of Durham University.

Mr. H. C. Rose has left The Mond Nickel Co., Ltd., and joined the staff of the Atomic Energy Research Establishment, Harwell.

Mr. J. C. Ruckman has recently been awarded the degree of B.Sc. in metallurgy at Birmingham University, with honours class 2, division ii. He will shortly begin training for a short-service commission in the Education Branch of the R.A.F.

Mr. J. B. Russell has been appointed Metallurgical Engineer to the Nichols Wire and Aluminum Co., Davenport, Iowa. For the last seven years he had been with the Kaiser Aluminum and Chemical Corp., Spokane, Wash.

Mr. N. B. Rutherford has left Cam Gears, Ltd., to become Chief Metallurgist to British Oxygen Engineering, Ltd., Edmonton, London.

Professor Cyril Stanley Smith has been granted a year's leave of absence from his position as Professor of Metallurgy and Director of the Institute for the Study of Metals, University of Chicago. He will reside principally in London and will be occupied in research on the history of science. Support for the work has been given by the Guggenheim Foundation and the U.S. National Science Foundation. On his way to London, Professor Smith attended the International Conference on Peaceful Uses of Atomic Energy at Geneva as an advisory member of the U.S. delegation.

Mr. J. E. Srawley has left the Meehanite Metal Corp. and is now with the Arwood Precision Casting Corp., Brooklyn, N.Y.

Mr. M. Stap is now with Van Leer's Vatenfabrieken, Amsterdam.

Dr. C. Sykes, Managing Director of Thomas Firth and John Brown, Ltd., has been awarded the honorary degree of D.Met. by the University of Sheffield.

Mr. J. Sykes has been appointed a Director of Enfield Rolling Mills, Ltd., Enfield.

Mr. W. J. McG. Tegart has come to England from Australia and will be working in the Department of Metallurgy at Sheffield University.

Professor M. S. Thacker has been appointed Director of the Council of Scientific and Industrial Research, India.

Mr. T. Henry Turner, Research Department, British Railways, has been elected Chairman of the Corrosion Group of the Society of Chemical Industry.

Mr. T. Watson, a Director of General Refractories, Ltd., has been elected President of the Refractories Association of Great Britain.

Mr. F. T. Wheelwright has taken up an appointment with the Eastern Smelting Co., Penang, Malaya.

Dr. A. B. Winterbottom has been appointed Professor of Physical Metallurgy at the Norges Tekniske Høgskole, Trondheim. He was recently awarded the degree of Doctor Technicae for a thesis on " Optical Studies of Metal Surfaces ".

Dr. B. C. Woodfine has left the British Iron and Steel Research Association to join the Atomic Energy Department of the General Electric Co., Ltd., Erith, Kent.

Mr. F. N. Zein has left Leeds University, having obtained a Ph.D. degree in metallurgy, and has taken up a teaching post in the Department of Chemical Engineering, University of Alexandria, Egypt.

# LETTERS TO THE EDITOR

## Fine Slip in Fatigue

I was very interested in the beautiful observations on " slip-band extrusion " carried out by Forsyth and Stubbington,[1] especially so since the work appears to agree with a working hypothesis on fatigue failure suggested by our continued work at Melbourne.[2]

This work indicates that true fatigue (that is, cyclic deformation of small amplitude, uncomplicated by any superposed unidirectional flow) takes place primarily by fine slip. The fine slip is too small to be seen by optical microscope until it is multiplied by continued cyclic deformation into a coarse band. It is possible to watch the formation and intensification of such a band and to show that each band is a potential fatigue crack.

The band growth suggests how the fatigue crack may form. The method is indicated most easily by comparing the production of the coarse bands in fatigue with the production of similar bands in unidirectional plastic deformation. Thus, it is clear from Fig. 1 (*a*), and confirmed by electron microscope,

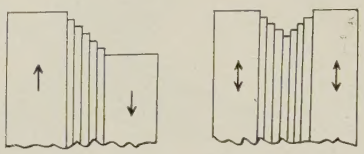


Fig. 1.

that in unidirectional deformation the fine slip movements in a coarse band in general can form at the specimen surface only a sloping set of steps, since the specimen has to deform as much as possible in one direction. But in cyclic deformation they can form a notch-like set of steps (Fig. 1 (*b*)); it is only necessary, for instance, that the fine slip movements in one direction should concentrate at the edges of the coarse band and those in the reverse direction at the centre of the band. Indeed, it is easy to demonstrate this difference between unidirectional and cyclic deformation by the familiar model of slip, namely, a pack of cards. Holding the top and bottom of the pack and shearing unidirectionally gives the steps of Fig. 1 (*a*). But moving the top and bottom to and fro soon develops notches like Fig. 1 (*b*). Having a reasonable mechanism for formation of a notch, we can without difficulty extend the hypothesis to account for the ultimate development of a crack in the slip band; the crack becomes simply the end-effect of a cumulative stress-concentration.

The hypothesis accounts also for other features of fatigue deformation; for example, the tendency of slip movements, having started a band, to concentrate in the region of the band as cycles continue; the sensitive way in which the life of a fatigue specimen depends on fine pits and scratches; and the erratic length of life after a certain minimum of cycles. The hypothesis will be confirmed if observations under high

magnification show the development of notches and irregular contours in coarse slip bands, and this the above observations by Forsyth and Stubbington, and our own observations seem to do; and so does the much earlier work of Ewing and Humfrey,[3] whose photographs still repay examination.

W. A. Wood

*The Baillieu Laboratory,*
*University of Melbourne.*

REFERENCES

1. P. J. E. Forsyth and C. A. Stubbington, *J. Inst. Metals*, 1955, **83**, (8), 395.
2. F. P. Bullen, A. K. Head, and W. A. Wood, *Proc. Roy. Soc.*, 1953, [A], **216**, 332.
3. J. A. Ewing and J. W. C. Humfrey, *Phil. Trans. Roy. Soc.*, 1903, [A], **200**, 241.

is essential for a true appreciation of the spatial distribution of the complex tunnel structure shown in the micrographs, which are reproduced so that a view from within the foil is obtained, that is, the tunnelling appears above the oxide replica from the unattacked foil surface.

The tubular nature of the oxide replica from most of the tunnels may be seen in the stereoscopic view; the nearer and farther walls of the larger tunnels clearly lie in different planes and indicate an approximately square tunnel section.

Considerable variation in tunnel size is shown, the smallest being ~0·07 μ across and the largest ~1·2 μ, and it is interesting to note that one tunnel, ~0·2 μ across, has proceeded for a distance approximately 80 times its width and has executed changes of direction while maintaining a remarkably uniform cross-section along its length.

The tunnel structure is clearly related to three mutually perpendicular directions, but a complete explanation of this form of attack has yet to be established.

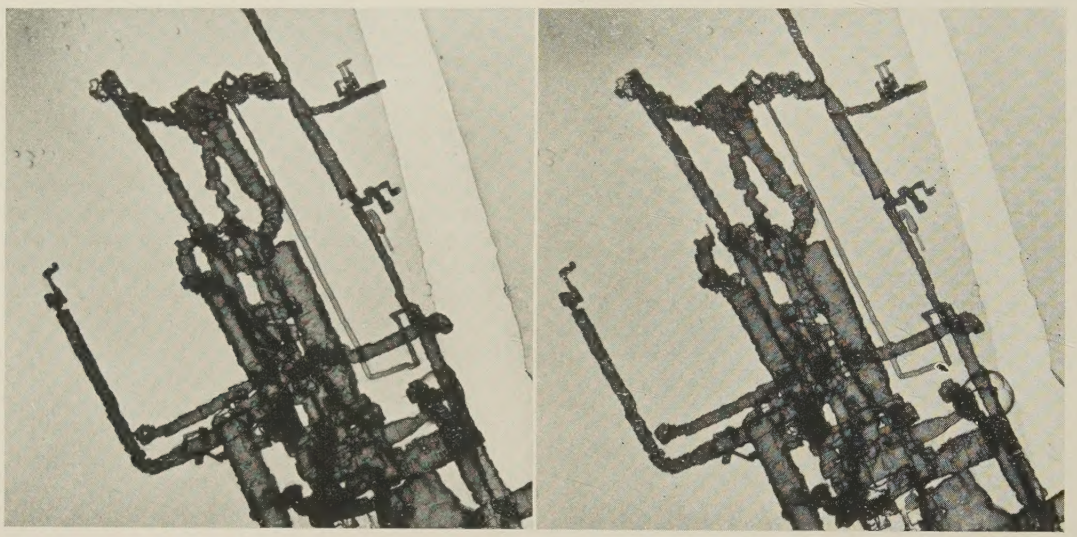

Fig. 1.—Stereoscopic Electron Micrographs of Tunnels Produced in 99·8% Pure Aluminium Foil by Electrolytically Etching in 0·01*N*-HCl + 12·3 g./l. NaCl. Oxide replica. × 3600.

## Tunnel Etching of Aluminium

A study of the pitting corrosion of commercial aluminium (Alcan 2S), on exposure to tap-water, has been made by Pearson, Huff, and Hay,[1] who showed that an unusual form of attack in the shape of tunnelling frequently occurred.

Studies, in the writers' Laboratories, of the etching of aluminium foils of 99·8% purity have shown that the form of attack may be restricted very largely to tunnelling, by the use of a suitable electrolytic etching technique. The method employed was to make the foil the anode in a bath consisting of 0·01*N*-HCl + 12·3 g./l. NaCl, maintained at a temperature of 90° C., with an aluminium cathode and a current density of 0·03 amp./cm.$^2$, the current being supplied from a battery. The etch structure produced by this method has been examined in the electron microscope by means of the oxide-replica technique, the replica being stripped in mercuric chloride solution.

Fig. 1 shows a stereoscopic pair of electron micrographs of tunnels produced by etching for 1 min. Stereoscopic viewing

Acknowledgements are due to Dr. L. G. Brazier, Director of Research and Education, British Insulated Callender's Cables, Ltd., for permission to publish this note.

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REFERENCE

1. E. C. Pearson, H. J. Huff, and R. H. Hay, *Canad. J. Technol.*, 1952, **30**, 311.

* Now at General Electric Company, Hudson Falls, N.Y., U.S.A.

# OTHER NEWS

### Discussion on Surface Reactions of Gases on Metals

The sixth annual meeting of the Société de Chimie Physique, to be held in Paris on 22–25 May 1956, will be devoted to a discussion on "Surface Reactions of Gases on Metals". The discussion will cover all the fundamental phenomena which determine the growth and structure of thin films formed by the reaction of a gas at a metal surface. Pure adsorption and catalysis will not be included, however.

The principal subjects to be dealt with are: (1) Recent advances in methods of studying thin films, (2) the kinetics of growth of thin films, (3) crystallographic relations between thin films and their support, (4) reaction anisotropy and morphology of the products of reaction, (5) effect of thin films on the surface structure and properties of the metal, and (6) the effect of thin films on the emission and absorption of various radiations by metals. Details may be obtained from the Secrétaire Général, Société de Chimie Physique, 10, rue Vauquelin, Paris (5e).

### National Certificates in Metallurgy

Rules 111, setting out the arrangements and conditions for the award of National Certificates in Metallurgy, have been revised by the Ministry of Education in consultation with the Iron and Steel Institute, the Institution of Mining and Metallurgy, the Institute of Metals, and the Institution of Metallurgists.

Copies of the revised Rules may be obtained from H.M. Stationery Office, price 4*d*.

### Congress on X-Rays

The Low-Temperature Group of the Physical Society, in conjunction with the Institute of Physics, is organizing a congress on "Low-Temperature X-Ray Crystallography" to be held at the Clarendon Laboratory, Oxford, on Thursday and Friday, 12 and 13 April 1956. Those interested should communicate with the Hon. Secretary of the Low-Temperature Group, Mr. F. Din, The British Oxygen Co., Ltd., Research and Development Department, Deer Park Road, London, S.W.19.

### Commonwealth Welding Conference

The Council of the Institute of Welding has decided to hold a Commonwealth Welding Conference in London in the summer of 1957. The objects of the Conference will be: (1) to promote an exchange of information on the present technical position of the welding processes and their main applications within the British Commonwealth; and (2) to consider means of improving the exchange of technical information among the countries of the Commonwealth.

It is intended that the Conference shall be open to all who are interested in welding; invitations to appoint official delegates will be addressed to the welding societies and Government Departments of the Dominions and Commonwealth territories. An organizing committee has been appointed under the Chairmanship of Mr. A. Robert Jenkins, J.P., M.I.Mech.E., and further announcements will be made from time to time.

### International Plansee Society for Powder Metallurgy

During the International Seminar on Powder Metallurgy held in Reutte (Austria) from 20 to 24 June 1955, the representatives of fourteen nations recognized the necessity for closer co-operation and formed the "International Plansee Society for Powder Metallurgy", an international organization for the promotion of powder metallurgy.

The aims of the new society are: (*a*) to promote a better understanding and exchange of ideas among powder metallurgists in the non-Iron-Curtain countries; (*b*) to hold international meetings at Plansee, Reutte, every two to three years; (*c*) to prepare a powder-metallurgy dictionary with the terminology and explanations of powder-metallurgy terms in the English, German, and French languages; and (*d*) to translate important articles in the field of powder metallurgy into the languages of the national sections.

Professor Gustav F. Hüttig, well-known in the field of powder metallurgy, was elected President of the new Society. Dr. Henry H. Hausner was elected Vice-President, and Dr. F. Benesovsky is the first Secretary.

Powder metallurgists interested in joining the new Society should contact one of the above-mentioned members of the Executive Board for further information. Their addresses are: Professor Gustav F. Hüttig, Technische Hochschule, Rechbauer Strasse 8, Graz, Austria; Dr. Henry H. Hausner, Atomic Energy Division, Sylvania Electric Products Inc., Bayside, New York, U.S.A.; and Dr. F. Benesovsky, Metallwerk Plansee, Reutte (Tyrol), Austria.

### International Foundry Congress, 1956

The 1956 International Foundry Congress is being organized by the Verein Deutscher Giessereifachleute and will take place in Düsseldorf from 1 to 9 September 1956. An International Foundry Trade Fair will be held simultaneously at the exhibition grounds in the city.

# APPOINTMENTS VACANT

**ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL,** has vacancies in its METALLURGY DIVISION. There are two main fields of work:

(*a*) The study of materials to be used in new reactors being developed for the production of nuclear power. The work will involve the use of X-ray-diffraction techniques, and experience in these techniques would be an advantage.

Appointments in this field will be made in the following classes:

(i) SCIENTIFIC OFFICER CLASS—Quote 2/103/374.
(ii) EXPERIMENTAL OFFICER CLASS—Quote 2/103/376.

(*b*) The study of ceramics and cermets for application as fuel elements and moderators for nuclear reactors. Applicants should have had considerable experience in the high-temperature field, both in fabrication and testing techniques.

Appointments in this field will be made in the following class:

SCIENTIFIC OFFICER CLASS—Quote 2/103/375.

*Scientific Officer Class:* Minimum qualifications are a second class Honours Degree in Physics, Chemistry, or Metallurgy. Successful candidates will be appointed either in the Grade of Senior Scientific Officer (£1040–£1205 p.a.) or Scientific Officer (£505–£905 p.a.) according to age, experience, and qualifications.

*Experimental Officer Class:* Minimum qualifications are Higher School Certificate in science subjects, or equivalent qualifications. Successful candidates will be appointed either in the grade of Experimental Officer (minimum age 26, £775–£945 p.a.) or Assistant Experimental Officer (£310 at age of 18—£685 p.a.) according to age, experience, and qualifications. Rates for women are slightly lower.

Successful candidates will be required to join the Authority's contributory superannuation scheme. Requests for application form should be sent on a POST CARD to the Establishment Officer, U.K. Atomic Energy Authority, A.E.R.E., Harwell, Didcot, Berks., quoting the appropriate reference.

**AUSTRALIA—UNIVERSITY OF MELBOURNE**

Applications are invited for the position of PROFESSOR OF METALLURGY.

The salary will be not less than £A3000 per annum, and superannuation similar to F.S.S.U. will be provided.

Further particulars and information as to the method of application may be obtained from the Secretary, Association of Universities of the British Commonwealth, 36 Gordon Square, London, W.C.1.

The closing date for the receipt of applications, in Australia and London, is *30 September 1955*.

**IMPERIAL CHEMICAL INDUSTRIES, LTD., NOBEL DIVISION,** requires Metallurgists in the grade of Assistant Technical Officer, for the Research Department at Stevenston, Ayrshire. Candidates should have a Pass Degree in Metallurgy, or its equivalent. Application should be made in writing to the Staff Manager, 460 Sauchiehall Street, Glasgow, C.2, quoting reference ABC.1.

**MAGNESIUM ELEKTRON, LIMITED**

Magnesium Elektron, Limited, require an experienced development engineer for their works near Manchester. Duties will involve the development of applications and of methods of production of wrought magnesium alloys for aircraft and other industries. Applicants should be between 25–35 and possess good engineering degree or equivalent. They should be energetic, of an adaptable nature, and have a strong personality with common sense and a practical outlook. Experience in the aircraft or motor industry would be an advantage. Salary would be according to qualifications and experience, but not less than £900 per annum. Contributory pension scheme embodying life asssurance. Apply, quoting IM.JL29, to Secretary, Magnesium Elektron, Limited, P.O. Box No. 6, Lumm's Lane, Clifton Junction, Swinton, Manchester.

**METALLURGICAL ASSISTANT** required for well-equipped laboratory. Experience in Metallography essential. Minimum requirements L.I.M. or similar qualification. Write, giving full particulars, including age and salary expected, to Manager, Engineering Department & Labour, Vickers-Armstrongs (Engineers) Ltd., Crayford, Kent.

**METALLURGIST.** Fully experienced man required to control heat-treatment section operating latest " EFCO " Furnace and cover checking analysis incoming materials bought to American specifications. Liaison between suppliers of castings, forgings, and bar stock would have to be carried out. Must be capable of setting up own laboratory and installation of records covering history of batch materials. Used to dealing with correspondence between customers and factory. Experience as stress man would be added qualification. Salary in line with experience. Excellent superannuation scheme in operation. Reply Box No. 395, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

**METALLURGIST** with good Honours degree, preferably with some experience of research required by British Insulated Callender's Cables, Ltd., in their Shepherds Bush Research Laboratories for investigation of metallurgical problems in the cablemaking industry. The candidate should be in the age range 22/27 years. Pension Fund. Five-day week. Applications in the first instance should be in writing, giving full particulars of age, qualifications, and experience, to the Staff Officer, British Insulated Callender's Cables, Ltd., 21 Bloomsbury Street, London, W.C.1, quoting reference L/97/55.

**METALLURGISTS** required for research and development work on magnesium-base alloys. Preference given to men with good honours degree, but other applications will be considered. Permanent appointment with contributory pension and life assurance. Apply stating reference IM.JL7, age and details of qualifications and experience to Secretary, Magnesium Elektron, Ltd., P.O. Box No. 6, Lumm's Lane, Clifton Junction, Swinton, near Manchester.

**METALLURGISTS FOR ATOMIC POWER PROGRAMME**

Physical Metallurgists are required for senior appointments in a new research and development group. These positions require young men with good honours degree or Ph.D. qualifications. Applications for interview should be addressed to:

The Personnel Manager,
Fraser & Chalmers Engineering Works,
Erith,
Kent.

**THE BRITISH THOMSON-HOUSTON CO., LTD.,** invites applications from qualified metallurgists and physicists for research on metallurgical problems of atomic reactors. There are openings for University graduates with or without research experience and for men with Higher National Certificate. Experience or interest in the mechanical properties of metals and alloys would be an advantage. Apply, quoting reference OCG, and stating age, qualifications, and experience to the Director of Research, British Thomson-Houston Co., Ltd., Rugby.

**THE IRON AND STEEL INSTITUTE** requires an assistant, male or female, in the Information Department (metallurgical enquiries and documentation, &c.). Some scientific training essential. Apply in writing, stating age, qualifications, experience, and salary required, to the Secretary, The Iron and Steel Institute, 4 Grosvenor Gardens, London, S.W.1.

**UNIVERSITY OF BIRMINGHAM**

DEPARTMENT OF INDUSTRIAL METALLURGY

Applications are invited for a lectureship in Industrial Metallurgy. The appointment will be in Grade II (salary £650 × £50 to £1350 p.a., with efficiency bar at £900, according to qualifications and experience, plus F.S.S.U. and family allowance). The successful candidate will be required to lecture in applications of modern physical methods to the examination of metal products and the control of manufacturing processes. Applicants should have experience of some of the following subjects: X-ray crystallography, non-destructive testing, optical methods of examination, gauging methods, and instrumentation of plant. The lecturer will be required to take up his duties not later than 1 January 1956. Applications should be submitted by 15 October 1955 to the Registrar, the University, Birmingham, 15. Further particulars may be obtained from the undersigned.

G. L. BARNES,
*Secretary.*

*The University,*
*Birmingham 15.*